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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/582,049	09/18/2000	Marcel Garnier	GARNIER-1	6845

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EXAMINER	
NGUYEN, NGOC YEN M	
ART UNIT	**PAPER NUMBER**
1754	

DATE MAILED: 11/17/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/582,049	GARNIER ET AL.	
	Examiner	Art Unit	
	Ngoc-Yen M. Nguyen	1754	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *September 5, 2006*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-4 and 7-12* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) *11 and 12* is/are allowed.

6)☒ Claim(s) *1-4, 7-10* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Claims 11-12 are allowed.

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 1-4, 7-8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yuge et al (5,182,091) in view of DE 29 24 584, Hanazawa et al (6,231,826) and optionally further in view of Aratani et al (5,961,944).

Yuge '091 discloses a method for purifying silicon which comprises directing a plasma jet of an inert gas toward the surface of molten silicon held in a container lined

with silica or a silica based refractory and stirring said molten silicon, said inert gas being mixed with 0.1-10 vol% steam (note claim 1). Yuge '091 discloses that it was found by small scale experiments that the adequate stirring of molten silicon reduces the loss of silicon below 10% during the purification process even though the amount of steam added to the plasma gas is increased to 10 vol%. Thus the stirring of molten silicon is essential. A better result is obtained when induction heating is applied to the molten silicon (note column 3, lines 37-44). Thus, Yuge '091 fairly teaches that induction heating is carried out not only to melt the silicon but also during the plasma treating step to improve the stirring of the molten silicon.

Yuge '091 discloses that although the process employs a plasma torch, which generates an arc therein, it is possible to make modification by applying the voltage across the plasma torch and the molten silicon (note column 3, lines 1-4). This modifica5tion is accomplished by making an opening in the bottom of the container and providing the bottom of the container with an electrode. The applied voltage generates an electron beam, which flows from the cathode of the plasma torch to the molten silicon (note column 3, lines 4-20). For higher productivity, it is desirable to carry out the procedure under reduced pressure (note column 3, lines 21-26).

The differences are (1) Yuge '091 does not specifically disclose plasma, which is generated by an inductive plasma torch and (2) Yuge '091 does not disclose the use of a "cold" crucible.

For difference (1), DE '584 discloses a process of producing silicon for solar cells by introducing silica or Si with a higher degree of contamination into a reducing gas

atmosphere in a plasma. The plasma is preferred to be an inductive plasma instead of an arc torch in order to avoid contaminating the molten silicon (note English abstract and page 4, last full paragraph).

It would have been obvious to one of ordinary skill in the art at the time of the invention was made use an inductive plasma instead of an arc plasma, as suggested by DE '584, in the process of Yuge '091 because the use of the inductive plasma would avoid contaminating the molten silicon.

For difference (2), Yuge '091 discloses that purification is accomplished by the removal of boron and carbon in the form of oxides. Oxygen to form oxides is furnished from the container wall of silica or silica-based refractory as the molten silicon is stirred. However, Yuge '091 further teaches that for more rapid carbon removal, it is desirable to add an oxidizing gas and/or silica powder to the plasma gas at the exit of the plasma torch (note column 2, lines 45-68).

Hanazawa '826 discloses a process for refining silicon (note title and claim 1). Hanazawa '826 teaches that high purity silicon having a purity of 00.9999% (6N) or more is required for use as a raw material for solar batteries (note column 1, lines 25-39). Hanazawa '826 further teaches that it is known in the art to use copper vessel, cooled with water, to prevent contamination caused by vessel materials (note column 1, lines 48-51 and column 2, lines 13-27). Hanazawa '826 also teaches that instead of the water-cooled copper vessel, a graphite vessel can be used because graphite vessel would improve heat efficiency, prevents contamination and is inexpensive (note abstract and column 3, lines 13-36). As shown in Figure 3, a solid state silicon layer 9 is formed

at the bottom of the graphite vessel 9 (note column 9, lines 27-28), thus, the graphite vessel as disclosed in Hanazawa '826 is considered the same as the claimed "cold" crucible.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use a "cold" crucible, either a water-cooled copper vessel or a graphite vessel, as suggested by Hanazawa '826 for the process of Yuge '091 because such vessel would prevent contamination caused by vessel materials. It should be noted as the purity for silicon is required to be higher, as suggested by Hanazawa '826, the use of silica vessel as disclosed in Yuge '091 would no longer capable of producing silicon with the required purity, one skilled in the art would have been motivated to switch to "cold" crucible as suggested by Hanazawa '826 and still achieve the goal of purifying the silicon as set out in Yuge '091 by adding oxidizing gas and silica (note column 2, lines 53-56) to provide the source of oxygen instead of the silica from the retainer walls.

Optionally Aratani '944 can be applied to teach that it is known and conventional in the art to melt silicon in a retaining container made of graphite or a water-cooling retaining container made of copper. The heating may be conducted by gas heating or electric heating (note column 5, lines 42-48).

Claims 9-10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yuge '091 in view of DE '584, Hanazawa '826, and Hiratake et al (4,048,436), optionally further in view Aratani '944.

Yuge '091, DE '584, Hanazawa '826 and optionally, Aratani '944 are applied as stated above.

Yuge '091 fairly teaches the inductive crucible and DE '584 the inductive plasma torch. Yuge '091 also disclose a bottom opening 13 (note Figure 4). The silica 1a in the bottom opening 13 is kept cooled and solidified, and it permits the electric current to flow to the water cooled electrode. This considered the same as the claimed electromagnetic valve.

The difference is Yuge '091 does not disclose a removable magnetic yoke between the plasma torch and the crucible.

Hiratake '436 discloses that an inductively produced plasma can be enlarged by subjecting the plasma to the rotating magnetic field generated by the rotating magnetic field generating means 44e. Because the plasma is more heated at its surface rather than its interior by induction heating on account of the skin effect, the rotating magnetic field has an effect to heat the surficial portion rather at a low temperature by its nature besides the enlargement of the plasma. This effect further contributes to the homogeneous heating of the plasma (note Figure 10 and column 6, lines 24-55).

For the "for inverting a stirring direction of the silicon load" limitation, when this limitation is considered as a "means plus function" limitation, and based on the instant disclosure, such means is required to have a specific shape and property (i.e., a ring shape magnetic yoke), thus, the magnetic ring shape means "44e" (as shown in Figure 10) of Hiratake '436 is considered as the required means for inverting the stirring direction. Alternatively, since the means in the instant claim 9 already is required to

have the ring shape yoke and being magnetic, the limitation "for inverting a stirring direction" is considered as an intended use limitation. Such limitation is given little weight, In re Hack 114 USPQ 162. Furthermore, since the magnetic ring shape means as disclosed in Hiratake '436 has all the positive limitations as those of the required means, it would be capable of performing the same function.

It would have been obvious to one of ordinary skill in the art at the time of the invention was made enlarge the plasma in Yuge '091, by using a rotating magnetic field, as suggested by Hiratake '436, because an enlarged plasma with a wide and homogeneous temperature distribution can be obtained and the wider the plasma the more surface it can treat.

Applicant's arguments filed September 5, 2006 have been fully considered but they are not persuasive.

Applicants argue that Yuge discloses a quartz crucible with a heat insulating lining 3, which is not a "cold" crucible.

Hanazawa '826 and Aratani '944 are now applied as stated above to teach the use of cold crucible for melting silicon to prevent contamination caused by the vessel materials.

Applicants argue that Yuge teaches that the silica constituting the crucible wall is indispensable for carbon removal.

Yuge teaches that silica is indispensable for carbon removal, not the silica wall is indispensable. It should be noted that the silica powder can be added to the plasma

gas instead of a silica wall (note column 2, lines 45-68). When Yuge is taken in view of Hanazawa, one of ordinary skill in the art would have been motivated by the teaching of Hanazawa to use a cold crucible in order to prevent contamination caused by vessel materials to obtain a high purity silicon suitable to be used as solar cells, solar battery, etc. The removal of carbon as disclosed in Yuge can still be carried out by adding silica powder to the plasma gas, instead of from the container wall. It should be noted that the process of Yuge includes the use of an electron beam under vacuum, just as in the process of Hanazawa.

Applicants argue that Hanazawa teaches away from the use of cold crucible because they are inefficient.

The graphite vessels, as disclosed in Hanazawa, are considered as "cold" crucibles as required in Applicants' claims because in Applicants' specification, "cold" crucible is described as having a skull to prevent contamination (note page 5, lines 10-16) and the graphite vessels of Hanazawa do have the required "skull" which is solid stated silicon (note item (9) in Figures 3-4 and column 9, lines 27-28). There is disclosure in Applicants' specification to indicate that the cold crucible must have a water cooling system. In any event, Hanazawa teaches that water-cooled copper vessel can be used to produce silicon with high purity suitable to be used as solar battery, but the heat efficiency for such use is low (note column 2, lines 13-28). Thus, it would have been obvious to one skilled in the art to use water-cooled copper vessel to produce silicon for solar battery if the low energy efficiency is not a concern.

Applicants argue that Yuge does not state or explain what the arrows in Fig. 1 represent.

In Yuge, vigorous stirring of the molten silicon is desired and the molten silicon in Yuge would have the same movement as required in Applicants' claim 1 because it is stirred by using a plasma and an electron beam, just as in Applicants' claimed invention.

Applicants argue that the applied reference does not teach or suggest a coil supplied by an A.C. voltage.

The coil is fairly taught by Yuge, note item (4) in Figures 1-4. As for the A.C. voltage, it would have been obvious to use any known, conventional means to provide the heat to the coil of Yuge.

Applicants argue that Hiratake does not disclosed that the magnetic field generating means, i.e. Applicants' claimed magnetic yoke, is removable.

As stated in the above rejection, since the magnetic yoke used in Hiratake has the same shape as that of Applicants' claimed invention, it would be as "removable" as the claimed magnetic yoke.

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the

shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ngoc-Yen M. Nguyen whose telephone number is (571) 272-1356. The examiner is currently on Part time schedule.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mr. Stanley Silverman can be reached on (571) 272-1358. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9306 or (571) 273-8300.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed (571) 272-1700.

Ngoc-Yen Nguyen

Ngoc-Yen M. Nguyen
Primary Examiner
Art Unit 1754

nmn
November 13, 2006